



Data Paper

# Multi-year monitoring of Piping Plovers (*Charadrius melodus*) and other shorebirds in The Bahamas

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## Abstract

## Background

The Bahamas provides a wide range of crucial coastal habitats to many declining resident and migratory birds. Amongst these species is the Piping Plover (*Charadrius melodus*), whose breeding populations are all listed as federally threatened or endangered in the United States and Canada. This species winters in the southern U.S. and the Caribbean, including The Bahamas, spending most of the year on the wintering grounds. Nonetheless, prior to the census data presented here, reports of Piping Plovers from The Bahamas were few and incidental. Therefore, repeated surveys are essential to increase understanding of the distribution, abundance and movement patterns of Piping Plovers and other shorebirds in the Bahamian territory. This dataset provides information on the abundance and

distribution of the Piping Plover across multiple islands and much of the suitable habitat that exists in The Bahamas. It also provides some information on the variability of Piping Plover count data and presence of other shorebird species. Furthermore, these data may serve as baseline information on Piping Plover abundance and shorebird site occupancy by which to assess key candidate sites for protection and also future impacts of climate change, such as sea level rise and hurricanes.

## New information

The National Audubon Society (NAS), Environment and Climate Change Canada (ECCC) and the United States Geological Survey (USGS) conducted a multi-year shorebird census in The Bahamas. Surveys initiated by ECCC and many other collaborators were also part of a multi-year survival study. Censuses were conducted across 16 different islands between the years 2006 and 2020. These surveys were performed with the cooperation of the Bahamas National Trust (BNT), volunteer biologists and scientists from the United States and Canada. Biologists working with NAS, ECCC and USGS used satellite imagery, historical records and local knowledge from Bahamian residents to identify sites with suitable habitat for Piping Plovers. Experienced researchers visited each site during winter (November-February), identified and counted Piping Plovers and, when possible, other bird species in each of the sampled locations. In total, the resulting database holds 2,684 observations of 62 bird species, of which 77% belong to 24 shorebird species. Approximately 30% of all presence records belong to the Piping Plover. It is important to emphasise that the counts reported in this dataset represent minimum estimates of local shorebird assemblages. Since abundance and distribution of birds vary with changing conditions, representative estimates are best achieved via repeated surveys that reflect a range of conditions including timing (day, year, month), weather (wind direction and speed, precipitation), tide state etc.

## Keywords

occurrence, observation, coasts, Piping Plover, shorebirds

## Introduction

Shorebirds are a large avian taxa belonging to the order Charadriiformes, which are commonly called sandpipers, plovers, oystercatchers, avocets, stilts and phalaropes (Brown et al. 2001). They are often considered a group of particular conservation concern due to natural history traits that make them especially vulnerable to threats. These traits include slow reproductive rates, long-distance migration and dependence on a relatively small number of critical migration and wintering sites (Myers et al. 1987, Brown et al. 2001). Such dependence on multiple sites across the hemisphere during their life cycles make them highly sensitive to habitat loss and degradation, disruptions to prey base, hunting, environmental catastrophes (Myers et al. 1987, Brown et al. 2001, Donaldson et

al. 2001) and disturbance (Gibson et al. 2018, Palacios et al. 2022). Evidence suggests that long-distance migratory shorebirds have suffered steep declines in the Western Hemisphere since 1970, potentially losing 37-70% of their populations (North American Bird Conservation Initiative 2016, Rosenberg et al. 2019). As threats such as hunting, pollution, habitat loss and degradation and climate change increase, it is essential to identify and protect shorebirds and their habitats throughout their entire range (Myers et al. 1987, Brown et al. 2001, Donaldson et al. 2001).

The Bahamas and Caribbean are widely recognised as important migratory and wintering areas for shorebirds within the Atlantic Flyway, as they may spend half the year or more in these territories (Donaldson et al. 2001, Atlantic Flyway Shorebird Initiative 2015, Cañizares and Reed 2020). Both regions are home to diverse and significant shorebird habitats, including coastal wetlands, mangroves, tidal flats, mudflats, sandy beaches and lagoons. Historical bird surveys in these regions have started to highlight The Bahamas as a potentially critical area for migrating and wintering shorebirds (Cañizares and Reed 2020). In particular, Piping Plovers that breed on the Atlantic coast of North America (*Charadrius melodus melodus*) are found by the thousands on beaches, sandy islands, cays and intertidal flats of The Bahamas (Elliott-Smith et al. 2009, Elliott-Smith et al. 2015). Recent research has shown that The Bahamas supports at least 32% of the Atlantic Piping Plover population and up to 19% of the global population of this imperilled species, which is federally listed in the United States and Canada (Species at Risk Act, Statutes of Canada 2002, Elliott-Smith et al. 2015, Gratto-Trevor et al. 2016, Wildlife and Fisheries 2021). Therefore, shedding light on shorebird abundance and distribution patterns in The Bahamas is critical to understanding the full life cycle of species that migrate there and to identifying conservation priorities.

The Commonwealth of The Bahamas is an archipelago in the Western Atlantic Ocean, north of the Greater Antilles and southeast of Florida (Buchan 2000). With an area of approximately 13,878 km<sup>2</sup>, The Bahamas consists of more than 700 islands and 2,400 cays (Buchan 2000). The purpose of this paper is to report the results of multiple shorebird surveys, with a particular focus on Piping Plovers, conducted between 2006 and 2020 in The Bahamas. Survey data presented here were collected under three different projects: (1) Shorebird Conservation in The Bahamas, which was carried out by NAS in partnership with BNT; (2) Eastern Canada Piping Plover survival and movement study, initiated by ECCC; (3) International Piping Plover Census, which was coordinated in the Bahamas by the USGS, NAS and BNT.

## General description

**Purpose:** This work aimed to improve knowledge about the abundance and distribution of the Piping Plover and other shorebirds in coastal habitats of The Bahamas. This dataset provides valuable information for recognising the diversity of shorebirds present in this country, monitoring changes in species abundance and identifying key conservation sites.

## Sampling methods

**Description:** The surveys had the primary intention of increasing knowledge about the abundance and distribution of the Piping Plover in The Bahamas. Therefore, experienced researchers conducted sampling in habitats known to support wintering Piping Plovers, such as beaches and sandflats with low density of grasses and other types of vegetation. Sampled sites were located on multiple islands throughout the Bahamas (see geographic coverage description). Surveys were conducted during the wintering period of the Piping Plover in The Bahamas, which can extend from November to the end of February.

**Sampling description:** Census sites were selected, based on historical data from areas where Piping Plovers had been documented, analysis of satellite imagery to identify sites with habitat that might support Piping Plovers, local knowledge from Bahamian residents and sites discovered by census teams in the process of completing censuses. Some of these sites were repeatedly censused over the years, while others were progressively added to identify new wintering birds and increase the chance of recording new plover individuals through band resightings. It is important to consider that sites sampled multiple times have the same name, but may have different coordinates due to within-site variation in shorebirds' locations, tide level and habitat changes across the years. At each site, surveys were conducted on foot by researchers skilled in shorebird identification. The censuses conducted under the coordination of ECCC focused only on Piping Plovers, while those coordinated by NAS and the USGS included counts for other bird species when possible, following the same protocol for collecting Plovers' data. Surveyors covered all suitable Piping Plover habitats at each census site, excluding hard-to-reach areas, such as very large tidal flats with no boat access, remote islands and cays and dense mangroves. Additionally, protocols for carrying out surveys were adaptively revised, based on field experiences, and observers were advised to conduct surveys under favourable weather conditions and at medium to high tide levels to increase bird detectability. However, due to the remoteness of many sites, it was not possible to conduct all surveys at ideal times or tide levels and, therefore, counts presented here represent minimum estimates. Finally, in addition to recording birds' location and abundance, observers also reported the date, time, weather, tidal stage, presence or absence of leg-bands and any colour combinations or alphanumeric leg flags and surveyor information.

**Quality control:** Surveys were conducted by experienced shorebird researchers. All records were manually validated, verifying that the information reported in the dataset was consistent with the data collected in the field diaries.

## Geographic coverage

**Description:** Censuses were conducted in The Bahamas, primarily in coastal habitats. In particular, the dataset contains occurrence records across 16 different main islands and the associated cays within the archipelago: Abaco, Acklins, Andros, Berry Islands, Bimini, Cat Island, Crooked Island, Eleuthera, Exuma, Grand Bahama, Harbour Island, Inagua, Long Island, New Providence, Ragged Island and San Salvadore.

**Coordinates:** 20.9167 and 26.9479 Latitude; -79.3011 and -73.2619 Longitude.

**Taxonomic coverage**

**Description:** The dataset holds occurrence records of 62 bird species, classified in 21 families and 12 orders. The families with the highest number of recorded species were Scolopacidae (16 species), Ardeidae (10 species) and Laridae (9 species). Since most surveys focused on the Piping Plover and the habitat where it occurs, this species has ~ 30% of the total 2,684 presence records. The International Piping Plover Census also focused on other species of plovers. Thus, the number of Piping Plover records are followed by Wilson’s Plover (*Charadrius wilsonia*; ~ 9%) and Black-bellied Plover (*Pluvialis squatarola*; ~ 7%). Species that were encountered during Piping Plover surveys, but in habitat atypical of that used by Piping Plovers (i.e. shrub thickets, birds in flight at the census site, perching birds, raptors etc.) were also recorded. The taxonomic authority used was the American Ornithological Society's Checklist of North American Birds (Chesser et al. 2020).

**Taxa included:**

| Rank    | Scientific Name            | Common Name            |
|---------|----------------------------|------------------------|
| class   | Aves                       | Birds                  |
| species | <i>Actitis macularius</i>  | Spotted Sandpiper      |
| species | <i>Ardea alba</i>          | Great Egret            |
| species | <i>Ardea herodias</i>      | Great Blue Heron       |
| species | <i>Arenaria interpres</i>  | Ruddy Turnstone        |
| species | <i>Bubulcus ibis</i>       | Cattle Egret           |
| species | <i>Butorides virescens</i> | Green Heron            |
| species | <i>Calidris alba</i>       | Sanderling             |
| species | <i>Calidris alpina</i>     | Dunlin                 |
| species | <i>Calidris canutus</i>    | Red Knot               |
| species | <i>Calidris mauri</i>      | Western Sandpiper      |
| species | <i>Calidris melanotos</i>  | Pectoral Sandpiper     |
| species | <i>Calidris minutilla</i>  | Least Sandpiper        |
| species | <i>Calidris pusilla</i>    | Semipalmated Sandpiper |
| species | <i>Cathartes aura</i>      | Turkey Vulture         |
| species | <i>Charadrius melodus</i>  | Piping Plover          |
| species | <i>Charadrius nivosus</i>  | Snowy Plover           |

|            |                                       |                            |
|------------|---------------------------------------|----------------------------|
| species    | <i>Charadrius semipalmatus</i>        | Semipalmated Plover        |
| species    | <i>Charadrius vociferus</i>           | Killdeer                   |
| species    | <i>Charadrius wilsonia</i>            | Wilson's Plover            |
| species    | <i>Crotophaga ani</i>                 | Smooth-billed Ani          |
| species    | <i>Egretta caerulea</i>               | Little Blue Heron          |
| species    | <i>Egretta rufescens</i>              | Reddish Egret              |
| species    | <i>Egretta thula</i>                  | Snowy Egret                |
| species    | <i>Egretta tricolor</i>               | Tricolored Heron           |
| species    | <i>Eudocimus albus</i>                | White Ibis                 |
| species    | <i>Falco columbarius</i>              | Merlin                     |
| species    | <i>Falco peregrinus</i>               | Peregrine Falcon           |
| species    | <i>Fregata magnificens</i>            | Magnificent Frigatebird    |
| species    | <i>Geothlypis trichas</i>             | Common Yellowthroat        |
| species    | <i>Haematopus palliatus</i>           | American Oystercatcher     |
| species    | <i>Himantopus mexicanus</i>           | Black-necked Stilt         |
| species    | <i>Hydroprogne caspia</i>             | Caspian Tern               |
| subspecies | <i>Larus argentatus smithsonianus</i> | American Herring Gull      |
| species    | <i>Larus delawarensis</i>             | Ring-billed Gull           |
| species    | <i>Larus fuscus</i>                   | Lesser Black-backed Gull   |
| species    | <i>Limnodromus griseus</i>            | Short-billed Dowitcher     |
| species    | <i>Limosa fedoa</i>                   | Marbled Godwit             |
| species    | <i>Megaceryle alcyon</i>              | Belted Kingfisher          |
| species    | <i>Mergus serrator</i>                | Red-breasted Merganser     |
| species    | <i>Numenius phaeopus</i>              | Whimbrel                   |
| species    | <i>Nyctanassa violacea</i>            | Yellow-crowned Night-Heron |
| species    | <i>Nycticorax nycticorax</i>          | Black-crowned Night-Heron  |
| subspecies | <i>Pandion haliaetus carolinensis</i> | Osprey                     |
| subspecies | <i>Pandion haliaetus ridgwayi</i>     | Caribbean Osprey           |
| species    | <i>Pelecanus occidentalis</i>         | Brown Pelican              |
| species    | <i>Nannopterum auritum</i>            | Double-crested Cormorant   |
| species    | <i>Phalaropus tricolor</i>            | Wilson's Phalarope         |



|         |                                  |                           |
|---------|----------------------------------|---------------------------|
| species | <i>Phoenicopterus ruber</i>      | American Flamingo         |
| species | <i>Pluvialis squatarola</i>      | Black-bellied Plover      |
| species | <i>Rallus crepitans</i>          | Clapper Rail              |
| species | <i>Rynchops niger</i>            | Black Skimmer             |
| species | <i>Setophaga discolor</i>        | Prairie Warbler           |
| species | <i>Setophaga palmarum</i>        | Palm Warbler              |
| species | <i>Setophaga petechia</i>        | Yellow Warbler            |
| species | <i>Sterna dougallii</i>          | Roseate Tern              |
| species | <i>Sterna hirundo</i>            | Common Tern               |
| species | <i>Tachycineta cyaneoviridis</i> | Bahama Swallow            |
| species | <i>Thalasseus maximus</i>        | Royal Tern                |
| species | <i>Thalasseus sandvicensis</i>   | Sandwich Tern             |
| species | <i>Tringa flavipes</i>           | Lesser Yellowlegs         |
| species | <i>Tringa melanoleuca</i>        | Greater Yellowlegs        |
| species | <i>Tringa semipalmata</i>        | Willet                    |
| species | <i>Vireo crassirostris</i>       | Thick-billed <i>Vireo</i> |
| kingdom | Animalia                         | Animals                   |

Temporal coverage

Notes: 2006-01-09 through 2020-02-08

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Data resources

Data package title: Multi-year monitoring of shorebirds in The Bahamas

Resource link: <https://doi.org/10.15468/gwr8mg>

Alternative identifiers: [http://ipt.vertnet.org:8080/ipt/resource?r=bhs\\_shorebirds](http://ipt.vertnet.org:8080/ipt/resource?r=bhs_shorebirds)

Number of data sets: 1

Data set name: Multi-year monitoring of shorebirds in The Bahamas

Download URL: <https://www.gbif.org/dataset/6ce307d0-0456-4b74-b647-db0ace930b26>

Data format: Darwin Core

**Description:** The Bahamas provides a wide range of crucial coastal habitats to many declining resident and migratory birds. Amongst these species is one of the most threatened shorebirds in the United States and Canada, the Piping Plover (*Charadrius melodus*) (Elliott-Smith et al. 2015). This species winters in the southern US and the Caribbean, including The Bahamas, spending most of the year on the wintering grounds. However, despite various efforts to assess the populations of the Piping Plover and other shorebirds across the Caribbean, their movements, abundance and distribution patterns in this region remain poorly understood (Cañizares and Reed 2020 ). For this reason, the National Audubon Society, Environment and Climate Change Canada (ECCC) and the United States Geological Survey (USGS) conducted a multi-year shorebird census in The Bahamas. Surveys initiated by ECCC were also part of a multi-year survival study.

Censuses were conducted across 16 different islands between the years 2006 and 2020 (National Audubon Society et al. 2022). These surveys were performed with the cooperation of the Bahamas National Trust, volunteer biologists and scientists from the United States and Canada. Observers counted Piping Plovers and, when possible, other bird species in each of the sampled locations. In total, the dataset holds 2,684 observations of 62 bird species, of which 77% belong to 24 shorebird species. Additionally, 30% of all presence records belong to the Piping Plover, while four species have only one sighting and 29 have ten or fewer records.

It is important to emphasise that the counts reported in this dataset represent minimum estimates of local shorebird assemblages. Since abundance and distribution of birds vary with changing conditions, representative estimates are best achieved via repeated surveys that reflect a range of conditions including timing (day, year, month), weather (wind direction and speed, precipitation), tide state etc.

| Column label | Column description                           |
|--------------|--|
| occurrenceID | Global unique identifier for the occurrence. |



|                       |  |
|-----------------------|--|
| modified              | Most recent date the data set was modified. Date conforms to ISO 8601-1:2019.  |
| language              | Language of the dataset.   |
| license               | Statement of the rights assigned to the dataset.   |
| rightsHolder          | Organisation that manages data rights.   |
| accessRights          | Information about who can access the resource or an indication of use restrictions.                                    |
| institutionCode       | Acronym of the institution having custody of the data or information referred to in the record.                        |
| collectionID          | An identifier for the dataset from which the record was derived.   |
| bibliographicCitation | Reference indicating how the record should be cited when used.   |
| basisOfRecord         | The specific nature of the data record.  |
| eventDate             | Date when the occurrence was recorded. Date conforms to ISO 8601-1:2019.   |
| year                  | The four-digit year in which the occurrence was recorded, according to the Common Era Calendar.                        |
| month                 | The integer month in which the occurrence was recorded.  |
| day                   | The integer day of the month on which the occurrence was recorded.   |
| eventTime             | The time or interval during which an occurrence was recorded. Time conforms to ISO 8601-1:2019.                        |
| occurrenceRemarks     | Comments or notes about the occurrence.  |
| countryCode           | The standard code for the country in which the Location occurs. The code conforms to ISO 3166-1-alpha-2 country codes. |
| island                | The name of the island on or near which the Location occurs.   |
| locality              | The specific description of the place.   |
| samplingProtocol      | The methods or protocols used during sampling.   |
| samplingEffort        | The amount of effort expended during a sampling event.   |
| sampleSizeValue       | A numeric value for a measurement of the size of a sample in a sampling event.   |
| sampleSizeUnit        | The unit of measurement of the size of a sample in a sampling event.   |
| kingdom               | The full scientific name of the kingdom in which the taxon is classified.  |
| order                 | The full scientific name of the order in which the taxon is classified.  |
| family                | The full scientific name of the family in which the taxon is classified.   |
| genus                 | The full scientific name of the genus in which the taxon is classified.  |
| specificEpithet       | The name of the first or species epithet of the scientificName.  |
| infraspecificEpithet  | The name of the lowest or terminal infraspecific epithet of the scientificName, excluding any rank designation.        |

|                               |   |
|-------------------------------|---|
| scientificName                | The full scientific name, with authorship and date information, if known.   |
| taxonRank                     | The taxonomic rank of the most specific name in the scientificName.   |
| nameAccordingTo               | The reference to the source in which the specific taxon concept circumscription is defined or implied.  |
| scientificNameAuthorship      | The authorship information for the scientificName formatted according to the conventions of the applicable nomenclaturalCode.                                   |
| vernacularName                | A common or vernacular name.  |
| individualCount               | The number of individuals present at the time of the Occurrence.  |
| occurrenceStatus              | A statement about the presence or absence of a Taxon at a Location.   |
| organismRemarks               | Comments or notes about the Organism instance.  |
| decimalLongitude              | The geographic longitude (in decimal degrees, using the spatial reference system given in geodeticDatum) of the geographic centre of a Location.                |
| decimalLatitude               | The geographic latitude (in decimal degrees, using the spatial reference system given in geodeticDatum) of the geographic centre of a Location.                 |
| geodeticDatum                 | The ellipsoid, geodetic datum, or spatial reference system (SRS) upon which the geographic coordinates given in decimalLatitude and decimalLongitude are based. |
| coordinateUncertaintyInMeters | The horizontal distance (in meters) from the given decimalLatitude and decimalLongitude describing the smallest circle containing the whole of the Location.    |
| dataGeneralizations           | Actions taken to make the shared data less specific or complete than in its original form. Alternative data of higher quality may be available on request.      |
| fieldNotes                    | Text of notes taken in the field.   |
| informationWithheld           | Additional information that exists, but that has not been shared in the given record.   |

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